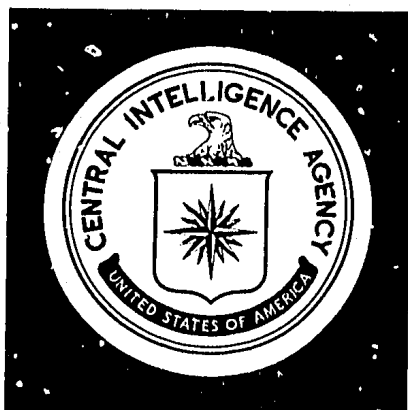


25X1

Approved For Release 2007/03/09 : CIA-RDP85T00875R001700040001-5

Approved For Release 2007/03/09 : CIA-RDP85T00875R001700040001-5

**Confidential**



DIRECTORATE OF  
INTELLIGENCE

# Intelligence Memorandum

*China: Decline in International Tungsten Position*

On file Department of Interior release  
instructions apply.

**Confidential**

Not referred to DOI. Waiver applies.

ER IM 72-118  
July 1972

Copy No. 86

25X1

Approved For Release 2007/03/09 : CIA-RDP85T00875R001700040001-5

Approved For Release 2007/03/09 : CIA-RDP85T00875R001700040001-5

**CONFIDENTIAL**

**CENTRAL INTELLIGENCE AGENCY**

Directorate of Intelligence

July 1972

**INTELLIGENCE MEMORANDUM**

**CHINA: DECLINE IN INTERNATIONAL TUNGSTEN POSITION**

**Summary**

1. Exports of tungsten concentrates from the People's Republic of China (PRC) have fallen to 7,100 metric tons, or about one-fifth of the 1958 peak level. Whereas China's exports before World War II amounted to as much as 85% of total world consumption, today they amount to about 10%.

2. Prices for tungsten concentrates in the world market have fluctuated widely over the past decade - reaching a low of \$7.50 per short ton unit (STU)<sup>(1)</sup> in 1962 and a high of \$81.32 per STU in 1970. Because the PRC is believed to have 80% of the world's proved tungsten reserves, traders and consumers have been concerned about China's potential for autonomous control or disruption of the market. Their fears, however, seem groundless, in view of the persistent decline in Chinese exports and the stabilizing effect of sales from the sizable US stockpile.

3. Exports have fallen, not because the PRC is stockpiling, but because the PRC is producing less tungsten and consuming more of it domestically. Rich surface deposits, easily located and mined with little equipment, have been depleted. At the same time, the industry has been denied suitable equipment to maintain production through exploitation of deeper and poorer deposits. Although the potential remains, the Chinese probably will not resume previous levels of tungsten production during the 1970s. Moreover, domestic consumption should continue to rise in step with the expansion of China's steel industry.

---

1. STU refers to any quantity of concentrate containing 20 pounds of tungsten trioxide (WO<sub>3</sub>), which is equivalent to 15.862 pounds of pure tungsten.

Note: This memorandum was prepared by the Office of Economic Research and coordinated within CIA.

**CONFIDENTIAL**

**CONFIDENTIAL**

### Introduction

4. Changes that have taken place in China's exports of tungsten concentrates have important implications for tungsten users and producers throughout the world. China is believed to have 80% of the world's proved tungsten ore reserves, and, before World War II, it supplied up to 85% of world consumption. Today the PRC supplies only 10% of world consumption. China's exports of tungsten concentrates fell by more than 80% from a high of 32,800 tons in 1958 to a low of 6,100 tons in 1969, with a slight recovery to 7,100 tons in 1970 and 1971 (see Table 1).

5. The decline in PRC exports is perplexing to both producers and users of tungsten concentrates. They wonder why a nation with abundant reserves of ore and a pressing need for foreign exchange would forgo potential sales. They fear that China may be withholding large stockpiles of tungsten concentrates that, if suddenly placed on the market, would drive the price so low that investments in tungsten inventories and mining facilities would be lost. Even if China has no stockpile, it is feared that a renewal of vigorous production could enable the Chinese to sell at such low prices that many other world producers would have to close their mines. A contradictory concern is that without imports from China the non-Communist world may develop an acute shortage of tungsten in the 1980s.

6. This memorandum discusses the reasons for the decline in China's exports of tungsten concentrates and examines the outlook for China's tungsten industry in the 1970s.

### Discussion

#### Economic Importance

7. Tungsten's unique combination of properties makes it the most satisfactory material for many uses. The most important of these properties are extreme hardness and high strength at high temperatures.<sup>(2)</sup> More than two-thirds of world production of tungsten concentrates is converted into high-speed tool steel or tungsten carbide tool bits. Both of these products are used in large amounts in the operation of metalcutting machine tools and drilling and excavating equipment. Other important applications include tungsten filaments for light bulbs, cathodes for electron tubes, and tungsten

---

2. For a brief account of the physical and chemical properties of tungsten, see Appendix A.

**CONFIDENTIAL**

## CONFIDENTIAL

Table 1

People's Republic of China:  
Production, Consumption, and Exports of Tungsten Concentrates<sup>a</sup>

Thousand Metric Tons <sup>b</sup>					
Year	Production	Domestic Consumption	Exports		Total World
			Non- Communist Countries	Communist Countries	
1952	18.6	0.3	0	18.3	18.3
1953	18.4	0.4	0	18.0	18.0
1954	18.5	0.6	0.4	17.5	17.9
1955	20.9	0.7	0	20.2	20.2
1956	26.3	1.1	0	25.2	25.2
1957	31.0	1.3	0.1	29.6	29.7
1958	34.8	2.0	0.8	32.0	32.8
1959	34.7	2.5	1.5	30.7	32.2
1960	29.6	3.3	1.6	24.7	26.3
1961	32.5	2.0	1.2	29.3	30.5
1962	22.8	2.0	1.7	19.1	20.8
1963	18.2	2.3	1.5	14.4	15.9
1964	13.9	2.5	1.8	9.6	11.4
1965	15.4	2.8	5.8	6.8	12.6
1966	14.8	3.0	8.2	3.6	11.8
1967	10.3	2.5	6.6	1.2	7.8
1968	9.5	2.9	4.2	2.4	6.6
1969	9.7	3.6	5.1	1.0	6.1
1970	11.6	4.5	3.8	3.3	7.1
1971	12.4	5.3	3.5	3.6	7.1

a. For a description of the methodology employed in making estimates, see Appendix B.

b. Standard concentrates containing 60% WO<sub>3</sub>.

CONFIDENTIAL

CONFIDENTIAL

carbide cores for armor-piercing ammunition. Moreover, although generally more expensive than molybdenum for the purpose, tungsten concentrates can be added to steel to raise its hot strength. New uses for tungsten are being found continuously, and world consumption is expected to continue to rise at 3% to 3.5% annually.

#### Tungsten Market Behavior

8. The world tungsten industry<sup>(3)</sup> is perennially concerned about PRC intentions and capabilities with respect to tungsten exports. It is well known that China has the potential capability to seriously disrupt, if not unilaterally control, the world market. Demand and supply in the international tungsten market are "price inelastic" -- that is, both the amount demanded and the amount supplied of tungsten concentrates are not very responsive to changes in market price. Buyers typically use tungsten as a small part of a larger product (steel) or assembly (armaments) and are not deterred from using tungsten by a rise in price; similarly, because tungsten is already being employed in those uses related to its unique blend of characteristics, a cut in price will not result in a rush of new users and uses, at least in the short run. On the supply side, producers cannot react immediately to price by raising or lowering productive capacity; investment decisions take time to make and to implement. Investors are chary of new commitments. They have experienced losses of investments in mines and inventories because of unanticipated sharp changes in world price levels. The specter of China as a giant producer that might flood the market is a disturbing factor in decisions to invest in tungsten mining throughout the world.

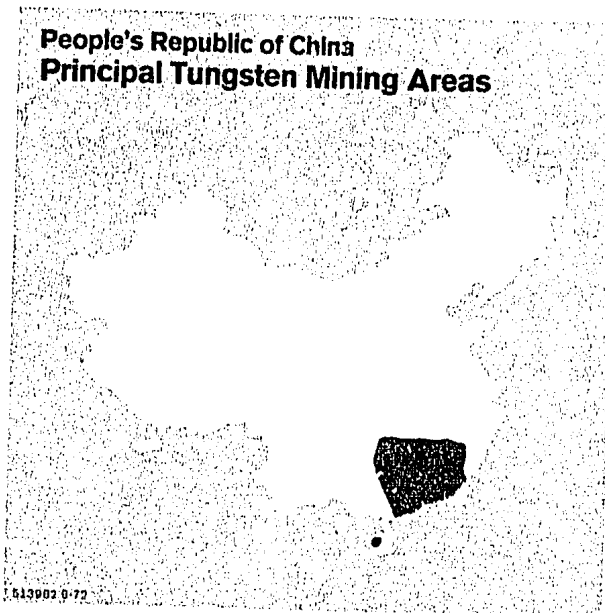
#### China's Reserves

9. China's reserves amount to 1,050,000 tons of contained tungsten metal, according to estimates made by Chinese mining experts in the 1920s and confirmed by qualified US observers in the 1940s. The veins of wolframite, China's richest deposits, are not as uniform as described in some

3. The world tungsten industry consists of mining companies, brokers dealing in concentrate, and firms that convert concentrate into products. Tungsten is traded principally by brokers in the United Kingdom and Continental Europe; selling prices are reported in *Metal Bulletin* (London). Tungsten is mined in significant amounts in the PRC, North and South Korea, Thailand, the USSR, Portugal, Rwanda, Canada, the United States, Mexico, Brazil, Peru, Bolivia, Australia, and Japan. The principal converters of tungsten are in the United States, the USSR, Japan, and Western Europe. The UN Committee on Tungsten holds periodic meetings to review the prevailing world tungsten situation. The world supply and prices of tungsten concentrates in the past decade are discussed in Appendix C.

CONFIDENTIAL

of the early Chinese reports. They are nearly vertical, tapering at depth, constantly varying in width, and intermittently broken by faults in a fashion typical of tungsten deposits elsewhere in the world. Most of the tungsten reserves are in the southeastern part of China, as shown on the map.



#### China's Tungsten Production

10. The declining trend in the production of tungsten in the PRC in the last decade does not seem to be related to the disruptions in overall development, such as the Leap Forward (1958-60) and the Cultural Revolution (1966-69). Moreover, there is no evidence that changes in the PRC's level of output have been induced by the wide swings in the world market price. The factors

responsible for the decline in output are to be found within the tungsten mining industry itself.

11. During the 1950s and early 1960s a substantial portion of China's output of tungsten ore came from rich, easily mined surface deposits discovered in the pre-Communist era. In response to Soviet urging and China's own need for foreign exchange, the established surface workings were mined vigorously until they became largely depleted in 1962-64. To bring new rich deposits into production would have required sizable investment in exploration and development and in mining and processing machinery.

12. Tungsten mining requires a continuous influx of capital just to maintain a stable level of production because operators must be constantly moving on to new pockets of ore. The Chinese have done little to sustain their tungsten industry. Improvements and expansions reported at tungsten mines and mill sites since the early 1960s have been negligible. The geological exploration teams currently combing the countryside for mineral deposits are not concentrated in likely tungsten producing areas as they might be if China had serious intentions of raising tungsten exports.

13. The amount and quality of tungsten concentrates yielded by specific mining operations depend not only on the grade of the ore but also on



**CONFIDENTIAL**

the capacity of the concentrating plants. When the Chinese ran out of easily mined high-quality ore, they could have maintained their level of output of concentrates by mining a larger amount of lower quality ore and enlarging the capacity of concentrating facilities. Both of those measures require substantial capital expenditures. China has many competing uses for its investment resources for both the expansion of industry and the modernization of the armed forces. Other things being equal, priority is given to those industries in which China lacks self-sufficiency as opposed to those with an export potential, especially those that are capital-intensive. The capital goods required to expand the extraction and concentration of tungsten ore are produced domestically but are in short supply and have more important alternative uses in the production of copper and other metals that China still must import in large amounts.

14. As for processing tungsten concentrates into metal, complex chemical and metallurgical equipment, also in short supply in China, are required. China has some wire drawing equipment for reducing tungsten wire to fine filament size but does not have adequate tungsten refineries or furnaces to sinter tungsten powder into solid bars. China does have a rolling mill for refractory metals in which the thickness of imported tungsten sheets can be reduced.

#### China's Requirements

15. The rise in the PRC's domestic consumption of tungsten, shown in Table 1, is attributable to three factors internal to the economy -- growth of the steel industry, a scarcity of alternative alloying materials, and an expanding weapons production program. Most tungsten is used ultimately for either strengthening or shaping steel products, and its consumption in China has risen to new heights along with the growth of steel output. Ferrotungsten is a substitute for the ferroalloys of chromium and molybdenum, which are in general use in the West for strengthening steel. China has minuscule chrome ore reserves, and although sizable molybdenum reserves have been identified, they have been exploited only on a small scale. The military's expanding need for high-strength low-alloy steels and armor piercing projectiles with tungsten carbide cores is a third factor in the strong domestic demand for tungsten.

16. In spite of the ability to produce surplus tungsten concentrates for export, the PRC has to import a number of finished tungsten products for which it lacks adequate fabrication capacity. Tungsten sheets, electrodes, and filament wire have predominated among imports. In 1971 the PRC imported nearly 12 tons of tungsten products worth \$420,000, mostly from Japan. This quantity is insignificant, compared with China's tungsten concentrate production. The high average price paid, about \$16.00 per

**CONFIDENTIAL**

CONFIDENTIAL

pound, reflects the high cost of refining tungsten and fabricating it into products. In contrast, the average world price of tungsten concentrates in 1970 was \$4.57 per pound of contained tungsten.

#### Stockpiling

17. Evidence on the volume, composition, and location of China's stockpiles of strategic metals is lacking. In 1968 and 1969, the PRC apparently expanded stockpiles of various deficit metals against the threat of war with the USSR. Because domestic production of tungsten remains far above domestic requirements, Peking presumably has not devoted resources to building large inventories of tungsten ores and concentrates. Moreover, as shown on the map, tungsten mining is located in southeast China, an area far removed from the Soviet threat. The PRC probably would wish to maintain sizable inventories of finished products that are imported -- tungsten sheets, electrodes, and filament wire. A year's supply of these products would total only about 12 tons.

#### Exports of Tungsten

18. In the 1960s, China's exports fell to about one-fifth of the 1958 high. Most of this decrease took the form of lowered shipments to Communist nations. In the early 1960s, Soviet receipts of concentrates were so large that the USSR resold a portion to the West. As long-term contracts to import from the PRC ran out in the mid-1960s, the USSR ceased also to be an exporter. In 1963, Peking began to seek markets for tungsten concentrates in the West. Heavy exports to non-Communist countries spurred in 1965-66, then tapered off over the succeeding five years. Sino-Soviet relations have been cool since 1960, and trade has dwindled. Nonetheless, the Soviets have never been completely cut off from supplies of Chinese tungsten.

19. Expansion of China's industrial output since the mid-1960s -- especially the expansion of output of steel and armaments -- has necessitated the retention of a significant portion of tungsten production for domestic use. Beginning in 1967, total exports of Chinese tungsten concentrates have stabilized at 6,000 to 8,000 tons. Tonnages shipped to the West have gradually declined in the last five years, while those to the Communist countries have turned back upward in the last two years. In 1971, approximately equal amounts went to both areas.

#### Market Influence

20. The PRC will not be able to control the tungsten market to its own advantage during the next several years. Until the late 1970s the

CONFIDENTIAL

**CONFIDENTIAL**

greatest single influence in the world tungsten market will be sales from the US strategic stockpile. This stockpile held 203,000 tons at the peak in 1964. Since then, more than 75,000 tons have been sold. The present stockpile objective was set by the Office of Emergency Preparedness at 60,000 tons. Thus there is presently a surplus of about 70,000 tons of concentrates and upgraded forms of tungsten in the stockpile. An all-out Chinese sales drive could put marginal producers out of business, but China could not profit by monopolistic pricing in the aftermath of their failures because of the availability of supplies from the US strategic stockpile. The PRC is undoubtedly aware that the US stockpile could be manipulated to insure that no advantage could be gleaned from an attempt to take over the market. Any attempt to drive out rival sellers through a price war would only lead to large irretrievable economic losses during this decade.

21. Tungsten concentrates of Chinese origin have a limited appeal in the current world market. In recent years, brokers and consumers around the world have come to expect much of the Chinese concentrates to be of inferior quality. The process of concentration in the PRC is not always carried out to Western standards, and the Chinese probably retain the purest concentrates for their own use. The products delivered abroad frequently contain less than the standard 60% to 65% of tungsten trioxide ( $WO_3$ ) and contain more than the tolerable level of impurities. The Chinese thus must sell at a discount and are unable to satisfy consumers who require standard quality concentrates in their operations.

### Outlook

22. China almost certainly will not regain its predominant position in the world tungsten markets during the 1970s. Although China has unequaled tungsten ore reserves, production cannot rise substantially without new large investment. Meanwhile, China's domestic consumption will continue to rise and cut more deeply into the exportable surplus. Even with an all-out effort to expand the tungsten industry, it would take at least two to three years for new mines to become productive.

23. China places highest priority on development of mineral industries for the products of which there is a domestic shortage. The Chinese are more interested in developing domestic sources of bauxite and copper ore, for example, than in producing tungsten concentrates for export. Peking will be reluctant to shift mining investment into tungsten production during the foreseeable future, yet more investment will clearly be required to take care of domestic requirements even if exports are allowed to dwindle further.

**CONFIDENTIAL**

CONFIDENTIAL

24. In short, even if it wished, the PRC is not likely to take the disruptive actions feared by the international tungsten traders. On the one hand, industries with higher priority claims on available investment means will continue to prevent wholesale expansion of tungsten mining. On the other hand, the countervailing influence of sales and potential sales from the US strategic stockpile is likely to remain effective in the 1970s.

CONFIDENTIAL

## CONFIDENTIAL

### APPENDIX A

#### Properties of Tungsten

Tungsten, also known as wolfram, has an atomic number of 74 and an atomic weight of 183.92. Tungsten is as heavy as gold, with a density of 19.3 grams per cubic centimeter, compared with iron (7.87), lead (11.35), uranium (18.7), and platinum (21.45). Tungsten is the heaviest metal that is available for structural application. It is occasionally employed for its weight alone for balancing rotating parts where space is limited. Tungsten has the highest melting point of any element - 3400° C (6150° F) compared with 1480° C for steel and 1769° C for platinum.

The property that contributes most to tungsten's usefulness is ability to impart hardness and strength at high temperatures. Although pure tungsten has a hardness on the Rockwell C scale of only about 20 to 45, it imparts far greater hardness when blended into alloys. Tungsten carbide, second only to diamond in hardness, is about 80 on the Rockwell C hardness scale, whereas tungsten tool steel is 55 to 65, and ordinary carbon steel is about 30. The extreme hardness makes tungsten carbide and tungsten tool steel the best materials for use as cutting tools. In fact, cutting tools account for more than two-thirds of the tungsten consumed by industry.

Tungsten has the greatest tensile strength of all metals. It can be drawn as wire to a tensile strength of 590,000 pounds per square inch compared with a maximum of 200,000 pounds per square inch for high-strength carbon steel. Tungsten steel has a tensile strength of 60,000 pounds per square inch at 1480° C, the temperature at which steel becomes molten. Because tungsten retains such great strength at high temperature it is specified in certain alloys for jet engine blades, furnace fixtures, and similar high temperature structural applications.

Tungsten's unique physical properties are complemented by its good electrical conductivity - 5.6 microohms per centimeter - and high thermal conductivity - 0.397 calorie per centimeter per second per degree centigrade.

CONFIDENTIAL

~~CONFIDENTIAL~~

## APPENDIX B

Methodology for Estimates  
of Production, Consumption, and Exports  
of Tungsten by the PRC

In the absence of official statistics, estimates of production, consumption, and exports of tungsten by the PRC must be pieced together from various sources. The export statistics are reasonably accurate because they are compiled from the official trade data of China's trading partners, as supplemented and confirmed by information on specific shipments and planned shipments.

The domestic consumption of tungsten is estimated from its correlation with the output of crude steel (see Table 2). In industrialized countries, the coefficient representing this relationship has been fairly constant, generally changing only with major economic changes, such as mobilization for a major war. China's tungsten consumption is estimated to be about 250 metric tons per million tons of crude steel produced. This coefficient falls between the US peacetime tungsten/steel ratio of about 150 metric tons per million tons of steel and the US wartime consumption of 300 metric tons per million tons of steel. The PRC, while not actually at war, has more of its industrial capacity on a war footing than the United States, hence the intermediate coefficient. The consumption figures are believed to be accurate to about plus or minus 30%.

The production figures given are sums of China's exports and estimated domestic consumption of tungsten concentrates for each year. Because inventories and stockpiles are thought to be negligible (see the Discussion), no attempt is made to account for their fluctuations. The production estimates are probably accurate to within 10% for all except the most recent years. Production estimates for the last three years may be in error by as much as 20%. Since domestic consumption is the more elusive component of the production estimate, estimates become more tenuous as the consumption portion of China's tungsten output expands.

If, contrary to the assumptions and judgments of this memorandum, Peking has stockpiled three years' supply of tungsten over the past decade, the production figures in Table 1 for the last ten years would be higher by an average of only about 10%.

~~CONFIDENTIAL~~

**CONFIDENTIAL**

Table 2

People's Republic of China:  
Estimated Consumption of Tungsten Concentrates  
Based on Crude Steel Production

Thousand Metric Tons		
<u>Year</u>	<u>Estimated Domestic Consumption of Tungsten Concentrates<sup>a</sup></u>	<u>Crude Steel Production</u>
1952	0.3	1,350
1953	0.4	1,770
1954	0.6	2,220
1955	0.7	2,850
1956	1.1	4,460
1957	1.3	5,350
1958	2.0	8,000
1959	2.5	10,000
1960	3.3	13,000
1961	2.0	8,000
1962	2.0	8,000
1963	2.3	9,000
1964	2.5	10,000
1965	2.8	11,000
1966	3.0	12,000
1967	2.5	10,000
1968	2.9	11,500
1969	3.6	14,500
1970	4.5	18,000
1971	5.3	21,000

a. Concentrates containing approximately 60% WO<sub>3</sub>.

**CONFIDENTIAL**

## CONFIDENTIAL

## APPENDIX C

Notes on the Behavior  
of the World Tungsten Market

The apparent world supply of tungsten concentrates shown in Table 3 is the sum of world mine production and sales from the US and the UK stockpiles. World mine production is compiled from statistics of the producing countries, supplemented by estimates for those countries not reporting. The United States and the United Kingdom are the only countries known to have released major amounts from stockpiles in the 1960s. The United Kingdom sold its entire stockpile of 4,800 tons during 1964-66. US stockpile sales since 1962 have totaled about 75,000 tons. The US stockpile as of mid-1972 amounts to approximately 130,000 tons.

Statistics on world tungsten consumption, while not complete, furnish a reasonably accurate trend in growth. World consumption in physical terms is growing at an average annual rate of about 3.3%.\* Deviations of consumption from the trend are produced by business cycles rather than by changes in the price of concentrates. In the short run, the need for tungsten is a reflection of technical requirements; in most instances, the cost of tungsten is only a small fraction of the cost of the finished product. Thus the demand for tungsten concentrates for fabrication is inelastic with respect to price changes, and new offers to sell by miners and government stockpilers cause rapid falls in price. On the other hand, an insufficiency of offerings caused by the closing of mines or government decisions to enlarge stockpiles drives prices up sharply because most buyers remain in the market as prices continue to rise.

Market prices of tungsten concentrates rose more than tenfold from the 1962 low of \$7.50 per STU to the all-time high in 1970 of \$81.32 per STU. Even though production has been rising rather steadily, consumption in 1963-68 exceeded apparent world supply, causing continual decreases in inventories. By the late 1960s, the market had begun to anticipate acute shortages. Prices went to record highs before being tempered by increased production and massive releases from government stockpiles. Prices in mid-1972 are down to about 1968 levels.

The PRC was an important contributor to the overproduction of tungsten concentrates in 1956-61, which precipitated a sharp drop in prices in the early 1960s. Because traders have been aware of China's sizable

\* US Department of the Interior, Bureau of Mines,

CONFIDENTIAL



**CONFIDENTIAL**

Table 3

**Tungsten Concentrates: World Market Supply and Prices**

Year	World Mine Production <sup>b</sup>	Sales from US and UK Stockpiles <sup>c</sup>	Apparent World Supply	Price <sup>a</sup>	
				Low	High
				US \$ per STU <sup>e</sup>	
Thousand Metric Tons <sup>d</sup>					
1961	84.3	0	84.3	11.25	19.00
1962	70.4	1.6	72.0	7.50	14.00
1963	57.1	0.4	57.5	7.75	11.50
1964	56.0	1.5	57.5	11.00	21.50
1965	59.8	4.5	64.3	18.75	31.25
1966	61.9	8.8	70.7	32.50	46.88
1967	55.4	6.4	61.8	39.38	47.19
1968	62.3	3.2	65.5	31.08	48.23
1969	64.2	38.3	72.5	36.98	69.13
1970	64.0	15.1	79.1	57.12	81.32
1971	66.3	1.4	67.7	34.30	65.42

a. Metal Bulletin, London.

b. Production figures for 1961-70 were taken from US Department of the Interior, Bureau of Mines, Minerals Yearbooks, 1960-70. The 1971 figure is a preliminary release from the Bureau of Mines. The figures are modified to include the PRC estimates from this study.

c. Minerals Yearbooks, 1960-70. Press Release, Joint Committee on Reduction of Non-Essential Federal Expenditures and Office of Emergency Planning (April 1964).

d. Concentrates containing 60% WO<sub>3</sub>.

e. STU (short ton unit) refers to any quantity of concentrate containing 20 pounds of WO<sub>3</sub>, which is equivalent to 15.862 pounds of pure tungsten.

tungsten reserves, they have had a recurring fear that the Chinese were about to flood the market with cheap tungsten. As shown in Table 1 and in the text, this fear seems to have been groundless in recent years.